

इंटरनेट

मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS/IEC 62255-4 (2006): Multicore and Symmetrical Pair/Quad Cables for Broadband Digital Communications (High Bit Rate Digital Access Telecommunication Networks) - Outside Plant Cables, Part 4: Aerial Drop Cables - Sectional Specification [LITD 6: Wires, Cables, Waveguides and Accessories]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE



भारतीय मानक

ब्रॉडबैंड डिजीटल कम्युनिकेशन हेतु मल्टीकोर एवं सिमेट्रिकल
युगल/क्वाड केबल (हाई बिट रेट डिजीटल एक्सेस टेलीकम्युनिकेशन
नेटवर्क्स) — संयंत्र के बाहर की केबल

भाग 4 एरियल ड्रॉप केबल — खंड विशिष्टि

Indian Standard

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES
FOR BROADBAND DIGITAL COMMUNICATIONS (HIGH
BIT RATE DIGITAL ACCESS TELECOMMUNICATION
NETWORKS) — OUTSIDE PLANT CABLES

PART 4 AERIAL DROP CABLES — SECTIONAL SPECIFICATION

ICS 33.120.10

© BIS 2010

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

NATIONAL FOREWORD

This Indian Standard (Part 4) which is identical with IEC 62255-4 : 2006 'Multicore and symmetrical pair/quad cables for broadband digital communications (high bit rate digital access telecommunication networks) — Outside plant cables — Part 4: Aerial drop cables — Sectional specification' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Wires, Cables, Waveguides and Accessories Sectional Committee and approval of the Electronics and Information Technology Division Council.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in the Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
IEC 60304 Standard colours for insulation for low frequency cables and wires	IS 9938 : 1981 Recommended colours for PVC insulation for LF wires and cables	Technically Equivalent
IEC 62255-1 : 2003 Multicore and symmetrical pair/quad cables for broadband digital communications (high bit rate digital access telecommunication networks) — Outside plant cables — Part 1: Generic specification	IS/IEC 62255-1 : 2003 Multicore and symmetrical pair/quad cables for broadband digital communications (high bit rate digital access telecommunication networks) — Outside plant cables: Part 1 Generic specification	Identical

The technical committee has reviewed the provision of the following International Standard referred in this adopted standard and has decided that it is acceptable for use in conjunction with this standard:

<i>International Standard</i>	<i>Title</i>
IEC 62255-4-1	Multicore and symmetrical pair/quad cables for broadband digital communications (high bit rate digital access telecommunication networks) — Outside plant cables — Part 4-1: Aerial drop cables — Blank detail specification

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Publication.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR BROADBAND DIGITAL COMMUNICATIONS (HIGH BIT RATE DIGITAL ACCESS TELECOMMUNICATION NETWORKS) — OUTSIDE PLANT CABLES

PART 4 AERIAL DROP CABLES — SECTIONAL SPECIFICATION

1 Scope

This sectional specification relates to IEC 62255-1.

This standard is applicable to aerial drop cables with or without a metallic screen over the cable core, a thermoplastic jacket, copper conductors, and solid or cellular insulation. These cables are typically available in 2 to 6 pair.

These cables are intended for aerial applications and are self-supporting.

The cables covered by this specification are differentiated by bandwidth and are classified by having a maximum reference frequency of 30 MHz, 60 MHz, or 100 MHz.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60304, *Standard colours for insulation for low-frequency cables and wires*

IEC 62255-1:2003, *Multicore and symmetrical pair/quad cables for broadband digital communications (high bit rate digital access telecommunication networks) – Outside plant cables – Part 1: Generic specification*

IEC 62255-4-1, *Multicore and symmetrical pair/quad cables for broadband digital communications (high bit rate digital access telecommunication networks) – Outside plant cables – Part 4-1: Aerial drop cables – Blank detail specification*

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 62255-1 shall apply.

4 Installation considerations

See Clause 4 of IEC 62255-1.

5 Materials and cable construction

5.1 General remarks

The choice of materials and cable construction shall be suitable for the intended application and method of installation of the cable.

5.2 Cable construction

The cable construction shall be in accordance with the materials, dimensions, and assembly details given in the relevant detail specification.

5.3 Conductor

The conductor shall be a solid annealed copper conductor having a diameter between 0,5 mm and 0,9 mm. Factory joints are permitted. The breaking strength of a joint shall not be less than 90 % of that of an unjointed conductor.

5.4 Insulation

The conductor shall be insulated with a suitable polyolefin material.

The type of the conductor insulation shall be solid or cellular or any combination thereof. The insulation may be made with or without a solid dielectric skin. The skin material may be different than the base material. Other multi-layer systems may be used.

The insulation shall be continuous and shall have a thickness such that the finished cable meets the specified requirements.

Joints in the insulated conductor are allowed. Joints shall be free from lumps and reinsulated with a non-hygroscopic dielectric material.

The nominal thickness shall be compatible with the method of conductor termination.

5.5 Colour code

The colour code of the insulation is not specified but shall be indicated in the relevant detail specification. The colours shall be readily identifiable and shall correspond reasonably with the standard colours shown in IEC 60304.

5.6 Cable element

The cable element shall be a twisted pair or quad.

5.7 Cable make-up

The cable elements shall be assembled into a circular core so as to provide the required number of pairs.

The core of the cable may be wrapped with a protective layer(s) of a non-hygroscopic material.

5.8 Filling compound

The core of the cable may be filled with a suitable water-blocking material. Examples of suitable materials are:

- polyethylene modified petroleum jelly;
- extended thermoplastic rubber;
- absorbent thixotropic gel;
- superabsorbent polymers with or without a carrier.

The material shall be compatible with the cable components with which it is in contact.

The type of material shall be indicated in the relevant detail specification.

5.9 Flooding compound

A flooding compound may be provided. Examples of suitable materials are:

- polyethylene modified petroleum jelly;
- absorbent thixotropic gel;
- superabsorbent polymers with or without a carrier;
- atactic polypropylene.

The material shall be compatible with the cable components with which it is in contact.

The type of material shall be indicated in the relevant detail specification.

5.10 Screening of the cable core

A screen for the cable may be provided.

A protective buffer (wrapped, longitudinally applied, or extruded) may be applied under or/and over the screen.

5.11 Sheath

The sheath shall consist of a suitable thermoplastic material applied over the cable core or screen, when present. Examples of suitable materials are:

- linear low density polyethylene;
- medium density polyethylene;
- high density polyethylene;
- polyvinyl chloride.

The polyethylene shall contain $(2,5 \pm 0,5)$ % by weight carbon black.

IS/IEC 62255-4 : 2006

5.12 Rip-cord

A rip-cord(s) may be provided. When present, the rip-cord shall be non-hygroscopic and non-wicking.

5.13 Colour of the sheath

The colour of the sheath shall be black, unless otherwise stated in the relevant detail specification. The sheath material shall be adequately stabilized to protect against long term exposure to ultraviolet radiation.

5.14 Strength members

The sheath of the cable may contain strength member(s). The strength member(s) may consist of a solid or stranded steel wire, which may be coated or bare. Alternately, the strength member(s) may consist of glass or synthetic fibre, or any combination thereof, which may have a polymeric coating.

5.15 Identification

The outer sheath of each length of cable shall be durably marked with the following information unless otherwise specified by the purchaser.

- Manufacturer's name or trademark.
- Year of manufacture.
- Pair count.
- Conductor diameter.
- Sequential length markings in metres.

5.16 Packaging of the finished cable

The method of packaging is not specified but may be indicated in the relevant detail specification.

6 Characteristics and requirements

This clause lists the characteristics and minimum requirements of a cable complying with this specification. Test methods shall be in accordance with Clause 6 of IEC 62255-1. A detail specification may be prepared to identify a specific product and its performance capabilities (see Clause 7).

6.1 Electrical characteristics and requirements

The tests shall be carried out on a cable length of not less than 100 m, unless otherwise specified.

6.1.1 Conductor resistance

The electrical resistance of any conductor when measured at or corrected to a temperature of 20 °C shall not exceed the values given in Table 1.

Table 1 – Conductor resistance

Conductor diameter mm	Resistance at 20 °C Ω/km
0,5	95,9
0,6	66,6
0,65	56,3
0,8	36,8
0,9	29,4

6.1.2 Resistance unbalance

The conductor resistance unbalance of a pair shall not exceed 2,0 %.

6.1.3 Dielectric strength

The insulation between each conductor and all other conductors in the finished cable and between all the conductors and the screen, when present, shall withstand a dielectric strength test. Two options are given depending on the level of voltage withstand capabilities required. The option to be used shall be indicated in the relevant detail specification.

6.1.3.1 High dielectric strength

The insulation between each conductor and all other conductors in the finished cable shall withstand the d.c. voltages given in Table 2 when tested for 3 s.

Table 2 – Test voltages

Conductor diameter mm	DC test voltage V	
	Solid insulation	Cellular insulation
0,5	3 000	1 200
0,6	3 600	1 400
0,65	4 000	1 500
0,8	4 500	1 600
0,9	5 000	1 700

NOTE An a.c. test voltage of $v_{dc}/\sqrt{2}$ may be used.

When a screen is present, the dielectric materials between all conductors and the screen shall withstand 10 000 V d.c. The test time shall be 3 s.

6.1.3.2 Low dielectric strength

The insulation between each conductor and all other conductors and between all the conductors and the screen, when present, in the finished cable shall withstand the d.c. voltages given in Table 3 depending on the duration of the test.

Table 3 – Test voltages

Type of insulation	Conductor to conductor		Conductor to screen	
	Duration of test		Duration of test	
	3 s	60 s	3 s	60 s
Solid	2 000 V	1 000 V	6 000 V	3 000 V
Cellular	1 000 V	500 V	2 000 V	1 000 V
NOTE An a.c. test voltage of $V_{dc}/\sqrt{2}$ may be used.				

6.1.4 Insulation resistance

The test shall be performed on:

- conductor/conductor;
- conductor/screen (when present).

The minimum insulation resistance at 20 °C shall not be less than 5 000 MΩ·km for unfilled cables and 1 500 MΩ·km for filled cables.

6.1.5 Mutual capacitance

The maximum individual mutual capacitance shall not exceed 58 nF/km.

6.1.6 Capacitance unbalance pair to pair

The maximum capacitance unbalance pair to pair between any two pairs in the finished cable shall not exceed 400 pF/km.

6.1.7 Capacitance unbalance pair to ground

The maximum capacitance unbalance pair to ground of any pair in the finished cable shall not exceed 1 600 pF/km.

6.1.8 Resistance of the screen

The d.c. resistance of the screen, when present, is not specified but may be indicated in the relevant detail specification

6.2 Transmission characteristics and requirements

All the tests shall be carried out on a cable length of 100 m unless otherwise specified.

NOTE By agreement with the user, cables having a maximum referenced frequency below 30 MHz may be specified following the transmission requirements for the 30 MHz cables.

6.2.1 Velocity of propagation and differential delay (delay skew)

6.2.1.1 Velocity of propagation

The minimum velocity of propagation of any pair shall not be less than 0,58 c (where c is the speed of light in a vacuum) for all frequencies between 1 MHz and the maximum referenced frequency.

6.2.1.2 Differential delay (delay skew)

For cables having a maximum referenced frequency of 100 MHz, the differential phase delay (delay skew) shall not exceed 48 ns/100 m.

6.2.2 Attenuation

The maximum attenuation at 20 °C, α , of any pair in the frequency range from 1,0 to the maximum referenced frequency shall not exceed the value obtained from equation (1) using the corresponding values of the constants given in Table 4.

$$\alpha = k_1 \cdot \sqrt{f} + k_2 \cdot f + \frac{k_3}{\sqrt{f}} \quad \text{dB at 100 m} \quad (1)$$

where f is the frequency in MHz.

Table 4 – Attenuation coefficients

Conductor diameter mm	Attenuation coefficients		
	k_1	k_2	k_3
0,5	1,967	0,023	0,050
0,6	1,797	0,021	0,046
0,65	1,695	0,020	0,043
0,8	1,364	0,015	0,035
0,9	1,121	0,010	0,028

6.2.3 Unbalance attenuation

The minimum unbalance attenuation near-end (transverse conversion loss or TCL) is not specified but may be indicated in the relevant detail specification.

6.2.4 Near-end crosstalk (PSNEXT)

The worst pair power sum near-end crosstalk, PSNEXT, of any pair in the frequency range 1 MHz to the maximum referenced frequency shall not be less than the values obtained from equation (2).

$$\text{PSNEXT}(f) = \text{PSNEXT}(1) - 15 \log(f) \quad \text{dB at 100 m} \quad (2)$$

where f is the frequency in MHz, and the value of PSNEXT(1) is given in Table 5.

Table 5 – Values of PSNEXT(1)

Maximum referenced frequency MHz	PSNEXT(1)
30	44
60	52
100	62

IS/IEC 62255-4 : 2006

6.2.5 Far-end crosstalk (PSELFEXT)

The worst pair power sum equal level far-end crosstalk, PSELFEXT, of any pair in the frequency range 1 MHz to the maximum referenced frequency shall not be less than the values obtained from equation (3).

$$\text{PSELFEXT}(f) = \text{PSELFEXT}(1) - 20 \log(f) \text{ dB at } 100 \text{ m} \quad (3)$$

where f is the frequency in MHz, and the value of PSELFEXT(1) is given in Table 6.

Table 6 – Values of PSELFEXT (1)

Maximum referenced frequency MHz	PSELFEXT(1)
30	44
60	52
100	61

6.2.6 Characteristic impedance

The characteristic impedance of any pair in the frequency range of 1 MHz to the maximum referenced frequency shall be $N \pm 15\%$ where N is the nominal value and is generally either 100 Ω , 120 Ω , or 135 Ω . The value of N shall be specified in the relevant detail specification.

6.2.7 Return loss (RL)

The minimum return loss of any pair in the frequency range of 1 MHz to the maximum referenced frequency shall not be less than the values, in dB, obtained from Table 7.

Table 7 – Return loss

Maximum referenced frequency MHz	Frequency range MHz		
	1 – 10	10 – 20	> 20
30	$15 + 2\log(f)$	17	$17 - 7\log(f/20)$
60	$17 + 3\log(f)$	20	$20 - 7\log(f/20)$
100	$20 + 5\log(f)$	25	$25 - 7\log(f/20)$

Where f is the frequency in MHz.

6.2.8 Screening attenuation

Screening attenuation is not specified but may be indicated in the relevant detail specification.

6.2.9 Transfer impedance

Transfer impedance is not specified but may be indicated in the relevant detail specification.

6.3 Mechanical and dimensional characteristics and requirements of the cable

6.3.1 Dimensional requirements

The nominal thickness of the sheath and the nominal overall diameter of the sheath are not specified, but shall be indicated in the relevant detail specification.

6.3.2 Elongation at break of the conductor

The minimum elongation at break of the conductor shall not be less than 10 %.

6.3.3 Elongation at break of the insulation

The minimum elongation at break of the insulation shall not be less than 300 %.

6.3.4 Elongation at break of the sheath

The minimum elongation at break of the sheath shall not be less than 100 %.

6.3.5 Elongation at break of the cable

Under consideration.

6.3.6 Breaking strength of the cable

The minimum breaking of the finished cable is not specified but may be indicated in the relevant detail specification.

6.3.7 Tensile strength of the sheath

The minimum tensile strength at break of the sheath shall not be less than 10 MPa.

6.3.8 Crush test of the cable

Not applicable.

6.3.9 Bending under tension of the cable

The bending under tension requirements are not specified but may be indicated in the relevant detail specification

6.3.10 Impact test of the cable

There shall be no cracking on the sheath or of the insulation when tested at $(-20 \pm 2) ^\circ\text{C}$ using a 0,45 kg weight dropped from a height of 1 m.

6.3.11 Cold bend test of the cable

There shall be no cracking of the sheath when tested at $(-20 \pm 2) ^\circ\text{C}$. The mandrel diameter shall be specified in the relevant detail specification.

6.3.12 Static load test of the cable

The static load characteristics of the finished cable are not specified but shall be indicated in the relevant detail specification.

IS/IEC 62255-4 : 2006

6.3.13 Adhesion of the aluminium screen

Not specified.

6.3.14 Sheath adherence

Not applicable.

6.3.15 Sheath integrity

The sheath shall withstand a spark test voltage of at least 8 kV r.m.s. or 12 kV d.c.

6.4 Environmental characteristics and requirements

6.4.1 Thermal oxidative stability

The minimum oxidative induction time of any pair in the finished cable shall not be less than 40 min for solid insulation and 60 min for cellular insulation.

6.4.2 Shrinkage of insulation

The insulation shrinkback shall not exceed 5 % when tested at $(115 \pm 1) ^\circ\text{C}$ for a period of 1 h.

6.4.3 Wrapping test of insulation after thermal ageing

Requirements for the wrapping test of insulation after thermal ageing are not specified but may be indicated in the relevant detail specification.

6.4.4 Bending test of insulation at low temperature

The insulation shall not crack when tested at $(-40 \pm 2) ^\circ\text{C}$ using a mandrel diameter equal to three times the outside diameter of the insulated conductor.

6.4.5 Elongation at break of the sheath after thermal ageing

The elongation shall not be less than 50 % of the un-aged value.

6.4.6 Tensile strength of the sheath after thermal ageing

The tensile strength at break shall not be less than 70 % of the un-aged value.

6.4.7 Sheath pressure test

Not applicable.

6.4.8 Static load test

Under consideration.

6.4.9 Flame propagation characteristics of a single cable

The flame propagation characteristics of the cable are not specified but may be indicated in the relevant detail specification.

6.4.10 Water penetration test

When water-blocking materials are used, there shall be no leakage from the end of the cable.

6.4.11 Wicking test

Binder, core wraps, and rip-cords shall be considered non-wicking if water does not wick by more than 75 mm in 6 h.

6.4.12 Hygroscopicity

Binders, core wraps, and rip-cords shall be considered non-hygroscopic if the gain in weight does not exceed 1 % in 3 h.

6.4.13 UV resistance

A polyethylene sheath shall be considered to be UV resistant if it contains $(2,5 \pm 0,5)$ % by weight of carbon black. The requirement for PVC sheaths is under consideration.

6.4.14 Compound flow

No more than 0,5 g of material shall have flowed from the cable sample after 24 hours at the test temperature. The test temperature shall be either (70 ± 1) °C or (80 ± 1) °C and shall be indicated in the relevant detail specification

The test shall be performed on three 300 mm samples. 130 mm of the sheath shall be removed from one end, and 80 mm of the screen(s) and core wrap shall be removed from the same end. The exposed pairs shall be flared to obtain reasonable separation. The samples shall be hung vertically in an air-circulating oven at the specified test temperature with the flared end pointing down.

6.4.15 Compatibility of the cable components with the filling and flooding compounds

The insulation and jacket shall retain a minimum of 85 % of their unaged tensile strength and elongation. There shall be no delamination of the coating, when present, from the metal screen or armour.

The test shall be performed on a sample of finished cable having a sufficient length to perform the required tests. Both ends of the sample shall be capped to prevent egress of the filling and flooding compounds. Age the sample in an air-circulating oven at 80 °C for 28 days. At the end of 28 days, remove the cable from the oven and allow to cool to room temperature. Measure the tensile strength and elongation of the aged insulation and sheath and compare them to measurements performed on unaged samples of the insulation and sheath. Also, remove the screen and visually examine the coating if present.

7 Introduction to the blank detail specification

The blank detail specification for cables described in this standard is published as IEC 62255-4-1 and should be used to identify a specific product.

IS/IEC 62255-4 : 2006

When completing the detail specification, the following information shall be supplied:

- a) conductor size;
 - b) number of elements;
 - c) cable construction details;
 - d) maximum referenced frequency;
 - e) nominal impedance.
-

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: LITD 06 (2098).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 2323 0131, 2323 3375, 2323 9402

Website: www.bis.org.in

Regional Offices:

Telephones

Central	: Manak Bhavan, 9 Bahadur Snah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 260 3843 260 9285
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	{ 2832 9295, 2832 7858 2832 7891, 2832 7892

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.